Basic Electrical Circuits

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Lecture – 81

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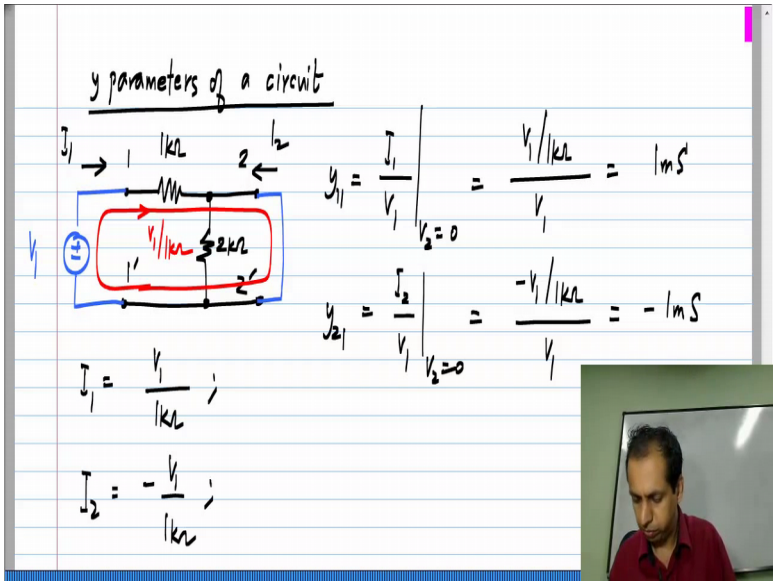

Now, I will take an example circuit and calculate it is y parameters. Let me take this circuit, this is port 1, this is port 2 very simple circuit, but for now let us use this and let say this is 1 kilo ohm and this is 2 kilo ohm and we want to calculate the y parameters and we will do it one by one using the algorithm we described earlier. So, y 1 1 is I 1 by V 1 with V 2 being shorted. So, I short the second port and I apply voltage V 1 to the first port. Now, it is clear that this V 1 appears entirely across this 1 kilo ohm, because of the short the voltage across the 2 kilo ohm the resistor is 0.

So, this current I 1 here is nothing but, V 1 divided by this resistance 1 kilo ohm. Now, what I wanted was I 1 by V 1, this turns out to be V 1 divided by 1 kilo ohm divided by V 1, which is equal to 1 by 1 kilo ohm or 1 millisiemens, so that is what y 1 1 is. Now, y 2 1 the measurement set up is the same, I still set V 2 to 0; that is short circuit the second port, but this time I measure I 2 instead of I 1. So, what do I get? I 2 and also keep in mind the direction of I 2, I 2 has to be measured that way.

Now, again this V 1 appears entirely across this 1 kilo ohm and because, this 2 kilo ohm

resistor has a short across it, no current can flow through the 2 kilo ohm resistors, the voltage across it is 0. So, we have a current like this in this direction, which is V 1 divided by 1 kilo ohm. If you look at I 2 it is the same as this current, but with the direction being opposite, so I 2 is simply minus V 1 by 1 kilo ohm. So, this is minus V 1 by 1 kilo ohm divided by V 1, which gives you minus 1 millisiemens, so that is the value of y 2 1.

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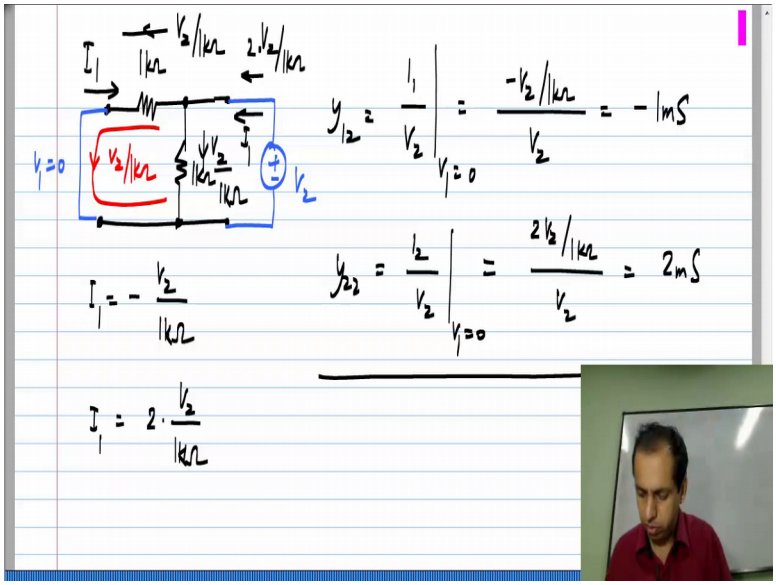

Now, let us consider the other parameters, we know that y 1 2 is I 1 by V 2 with V 1 set to 0, I have to short circuit port 1. So, let me do that, this is 1 kilo ohm; that is 1 kilo ohm, now I short circuit port 1 or set V 1 to 0 and apply V 2. So, if I apply V 2, what happens first of all there is a current V 2 by 1 kilo ohm in that direction and there is a current V 2 by 1 kilo ohm in that direction and the current that goes on here is the sum of the currents in the 2 resistors, which is V 2 by 1 kilo ohm times 2. It is basically this plus that.

Now, for y 1 2 what do I need? I want I 1, which is the current this way. I already evaluated that V 2 by 1 kilo ohm flows that way. So, I 1 is the negative of this, so I 1 is minus V 2 by 1 kilo ohm, which gives you minus V 2 by 1 kilo ohm divided by V 2, which is equal to minus 1 millisiemens. And finally, y 2 2 is I 2 by V 2 with V 1 equal to 0; that is, port 1 short circuited, same condition under which we measure y 1 2. So, I 1 which is this current we already calculated that, I 1 is 2 times V 2 divided by 1 kilo ohm. So, y 2 2 is 2 V 2 by 1 kilo ohm divided by V 2, which is equal to 2 millisiemens.

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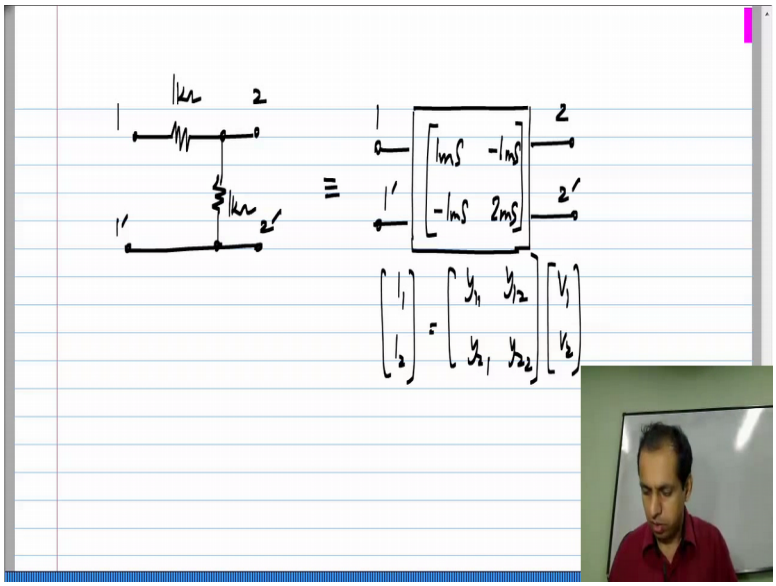

So, now, we have the circuit 1 kilo ohm and 1 kilo ohm 1 1 prime, 2 2 prime, the representation of this is as a two port network, 1 1 prime, 2 2 prime with y parameters, which are 1 millisiemens, minus 1 millisiemens, minus 1 millisiemens and 2 millisiemens. So, what can be done is instead of analyzing this circuit you can take this two port and the equation corresponding to that, which is basically I 1, I 2 being y 1 1, y 1 2, y 2 1, y 2 2 times V 1, V 2 and use that instead.

Now, this circuit is so simple that you can analyze anything even with this circuit in place, but you could have a 100 registers in here. As long as you know only two phase of terminals provided to you, it can be represented by only four parameters, the four y parameters. So, the calculations become a lot simpler, so this is an equivalent representation of that one, so that is all that is they do it.

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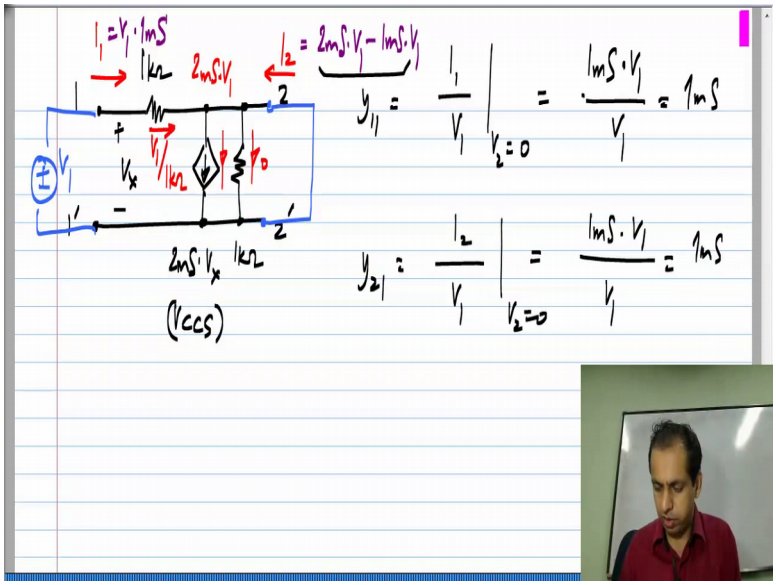

And we can take another example. This time I will use a control source, let me define this as V x and this is 2 millisiemens times V x. It is a voltage control current source and this is port 1, this is port 2. So, how do we go about determining the y parameters of this? Again exactly the same algorithm as before, so for y 1 1 you short port 2; that is you set port 2 equal to 0 and find the ratio of I 1 through V 1 and for y 2 1, you also short port 2 and find the ratio of I 2 to V 1.

So, in other words, what we do is we short circuit this, apply V 1 here and we need to find these two currents. We need to find this current I 1 and this current I 2, always please keep in mind where the currents go. This current is going in to the 2 port; that is in this part here or in this part over there and that is true both I 1 and I 2, so the directions are very important. Now, because I have shorted port 2 across this 1 kilo ohm, there is 0 volts and no current flows through this one and this V 1 appears entirely across the 1 kilo ohm resistor over here.

So, the current through this 1 kilo ohms resistor is V 1 divided by 1 kilo ohm and the current in this control source is nothing but, 2 millisiemens times V x and V x is the same as V 1 in this case, so this is 2 millisiemens times V 1. So, and that goes in that direction and current through is 0 as mention in earlier, so firstly, this I 1 simply equals this V 1 dived by 1 kilo ohm or V 1 times 1 millisiemens, because 1 by 1 kilo ohm millisiemens 1 millisiemens and this I 2 is nothing but, the current through the control source minus the current coming in from this resistors and that happens to be 2 millisiemens times V 1 that is, what going down in to this nothing to going here minus the current V 1 by 1 kilo ohm,

which is minus 1 millisiemens times V 1.

So, substituting this value we get I 1 is 1 millisiemens time V 1 dived by V 1, which is 1 millisiemens and this is this difference, which is also 1 millisiemens times V 1 dived by V 1, which is 1 millisiemens.

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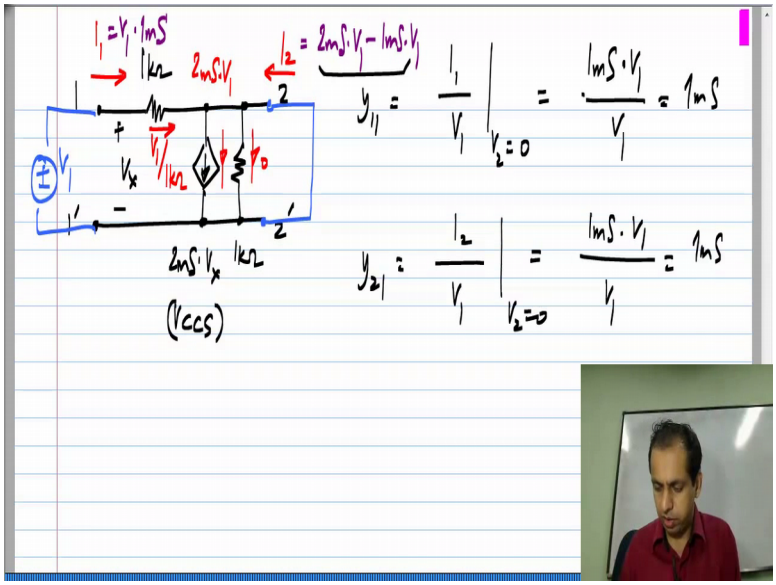

Then, we have to calculate the other 2 parameters we have to calculate y 1 2, which is I 1 by V 2 with port 1 shorted and y 2 2, which I 2 by V 2 with port 1 shorted. So, for these 2 measurement I have to short port 1 apply V 2 and I need to find the currents I 2 flowing that way and I 1 flowing that way. Now, I shorted this here, because this is shorted by the way this control source is 2 Millisiemens times V x, where this is V x and with port 1 short it V x equal 0, so this current source here will be 0 it is out of the picture.

Now, it is clear that this V 2 appears across this 1 kilo ohm as well as that 1 kilo ohm. So, we have current V 2 by 1 kilo ohm over there and a current V 2 by 1 kilo ohm over there. So, if I measure I 1 it is same as the current in this resistors and it is in opposite direction to the V 2 by 1 kilo ohm, so we have minus V 2 by 1 kilo ohm divided by V 2, which gives me minus 1 Millisiemens I 2, which is some of these 2 currents.

In fact, looking from this port if you look at the conductance seen at port to we see that the 1 kilo ohm 1 kilo ohm parallel. So, some of these to currents V 2 by 1 kilo ohm plus V 2 by 1 kilo ohm. So, that gives me 2 times V 2 by 1 kilo ohm divide by V 2, which is 2 Millisiemens. So, the y parameters of this networks the y matrix is 1 Millisiemens, 1 Millisiemens, minus 1 Millisiemens and 2 Millisiemens. So, again the point of this is you

can use this equation with only 4 parameters instead of looking at all the detail within the circuit.